Lecture Module - Electrical Signals

ME3023 - Measurements in Mechanical Systems

Mechanical Engineering

Tennessee Technological University

Topic 2 - Signal Analysis

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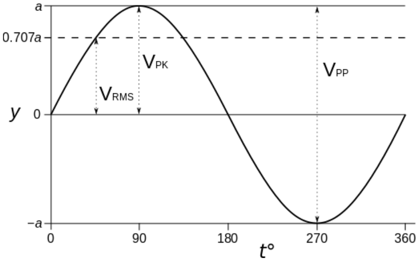
- Signal Mean Value
- Power Dissipation
- Signal Root Mean Square (RMS) Value
- Discrete-Time or Digital Signals

Signal Mean Value



Mean Value

$$\bar{y} \equiv \frac{\int_{t_1}^{t_2} y(t)dt}{\int_{t_1}^{t_2} dt}$$

Text: Theory and Design for Mechanical Measurements

Power Dissipation

Dissipation - Time Rate of Energy Dissipation

$$P = I^2 R$$

Total Electrical Energy

$$E = \int_{t_1}^{t_2} P dt = \int_{t_1}^{t_2} [I(t)]^2 R dt$$

Signal Root Mean Square (RMS) Value

- For a cyclically alternating electric current, RMS is equal to the value of the direct current that would produce the same average power dissipation in a resistive load.
- In Estimation theory, the root mean square error of an estimator is a measure of the imperfection of the fit of the estimator to the data.
- The RMS value of a signal having a zero mean is a statistical measure of the magnitude of the fluctuations in the signal.

Text: wikipedia

Signal Root Mean Square (RMS) Value

$$(I_e)^2 R(t_2 - t_1) = \int_{t_1}^{t_2} [I(t)]^2 R dt$$

$$I_e = \sqrt{\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} [I(t)]^2 dt}$$

$$y_{rms} = \sqrt{\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} [y]^2 dt}$$

Table 2.1 : Theory and Design for Mechanical Measurements

Discrete-Time or Digital Signals

$$\bar{y} = \frac{1}{N} \sum_{i=0}^{N-1} y_i$$

$$y_{RMS} = \sqrt{\frac{1}{N} \sum_{i=0}^{N-1} y_i^2}$$

Text: Theory and Design for Mechanical Measurements

Discrete-Time or Digital Signals

Table 2.1 : Theory and Design for Mechanical Measurements